POSIX.5b Test Suite
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Outline

- **Test suite development**   (FSU)
- **Certification program options**   (TOG)

Test Development Project

- **Develop validation test suite for POSIX.5b**

- **POSIX.5b is the Ada binding for POSIX.1b and POSIX.1c - the POSIX real-time extensions**

- **Also partially test core (non-real-time) interface**

- **The Open Group has tests for the core POSIX C-language bindings**

Motivation

- **Standards mean little w/o conformance testing**
  - benefits depend on conformance
  - several real-time kernels claim to support POSIX but do not exactly conform
  - all POSIX real-time features are optional

- **Tests can provide useful information**
  - whether implementation conforms to standard
  - which options are supported
  - whether functionality is usable

- **Goal = Portable applications on COTS OS products**

Who May Benefit?

- **Joint Strike Fighter**

- **Commercial Ada industry**

  – **Boeing & Lockheed**

- **AWACS - DIICOE/Real-Time Group**

- **Army ground & avionics domains**

-

Testing for API conformity helps insure
open systems architectures will really work.

POSIX.5b Test Suite Systems Engineering Plan

- **Start with Ada Compiler Validation Capability (ACVC) test format**

- **Extend to allow for POSIX options**

- **Develop tests incrementally, as series of prototypes**

- **Distribute prototypes via ftp for comment**
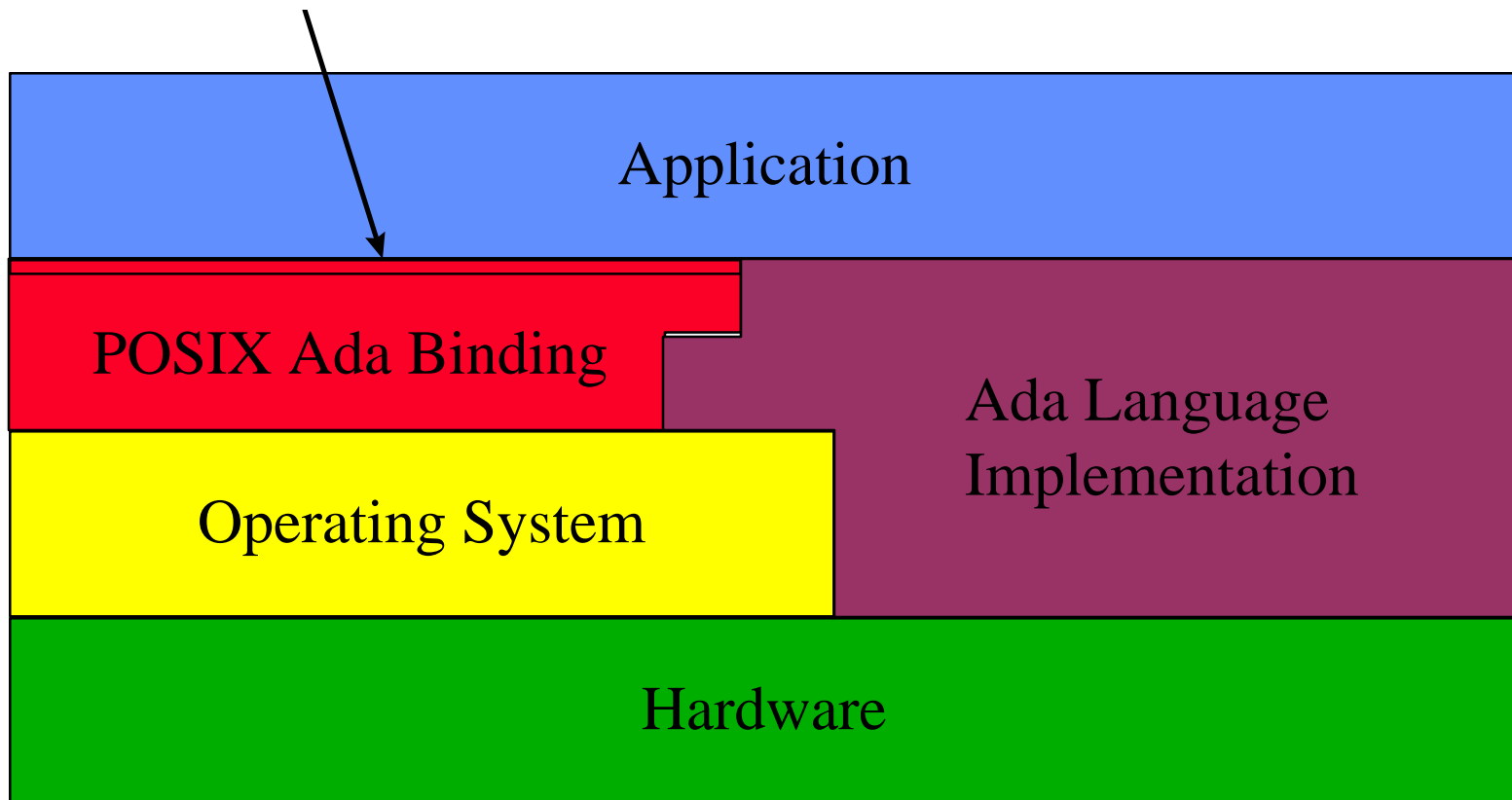
What is Tested?

- ## Ada compiler
  - ### e.g. GNAT

- ## Ada binding
  - ### e.g. Florist

- ## Underlying operating system
  - ### e.g. Solaris, IRIX, HP-UX, …
  - ### Embedded platforms needed

Tested interface

Application

POSIX Ada Binding

Operating System

Ada Language Implementation

Hardware

Schedule

- **First prototype**   October 1997
  - derived from existing FSU Florist tests
- **Second prototype**   December 1997
  - expanded coverage, more uniform style
- **Third prototype**   March 1998
  - 39 test programs, containing over 1450 checks
- **Fourth prototype**   June 1998
- **Final product**   September 1998
- **Maintenance**   ongoing
- **Sockets, XTI, POSIX.21…**

Directions for Next Stage of Test Development

- **Tests for uncovered sections of standard**
- **More checks in existing tests**
- **More application-driven tests**
- **Improve stylistic consistency and comments**
- **Improve traceability back to standard**
- **Cross-reference Ada tests to TOG assertions for the C-language interface, if possible?**

Comments & Suggestions Solicited

- **Potential POSIX.5b users:**

  – What **platforms** will be used?

  – How are these interfaces likely to be **used**?

  – Can you suggest **scenarios** for application-driven tests?

- **POSIX.5b implementers:**

  – Help **evaluating tests**?

  – Loan of **implementations** to test?

**Tests are available at
ftp://ftp.cs.fsu.edu/pub/PART/5btests
Send e-mail to baker@cs.fsu.edu
phone: (850) 644-5452**

Certification Options

- **Idea: integrate with Ada compiler validation**

- **Options**
    - **no certification**
    - **The Open Group**
    - **IEEE**
    - **others, e.g. ARA and AVF's**

The Open Group

Joe Bergmann
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- **Computer industry consortium**

- **Formed 2/96 from the merger of OSF (Cambridge MA) and X/Open (Reading UK)**

- **$55M**

- **Not for profit**

The Open
Group Activities

- **Customer Council**
  - Buy-side forum for direction and requirements

- **Research Institute**

- **Collaborative development**

- **Standards for Open Systems**

- **Test suite development**

- **Branding**

Testing and Branding

- **Bringing standards to market**

- **Business case**
    - **<u>not</u> funded through membership**
    - **we only invest if there is market demand**

- **Benefits to buyers and to suppliers**
    - **market growth**
    - **encouragement of choice and open competition**
    - **investment in useful differentiators**
    - **test development costs shared among suppliers**

- **Indicators of Compliance**
  - **continuous *not* snapshot**
  - **support Brand**
  - **self test**

- **Treated as S/W products**
  - **licences**
  - **support and maintenance service**

- **Development usually funded through advance license sales**

- **Must be self-sustaining**

THE *Open* GROUP

Some Current Programs

- ## UNIX
  - **extensive tests**
  - **procurement program**
    - **$25B to date**
    - **$5B in '97**
  - **funded by brand royalties and test suite revenue**

Certification for POSIX Ada

- **Development and management of a certification program**

- **Using the well tried processes of the Open Group branding program**

- **But:**

  - **no use of Open Group trademarks**

  - **platform based (like FIPS 151), not architecture**

  - **certificate of validation, not guarantee**

Backup Material

The following contain more
detailed information about
the POSIX.5b Test Suite.

Systems Eng. Approaches for Test Development

- **standard-driven**
- **application-driven**
  –

(not using test assertions)

Application-Driven Tests

- **Derived from abstract application scenario, e.g.**
    - clients and servers
    - communicating periodic tasks
- **Each program uses several POSIX packages**
- **Alternate solutions to a single scenario, using different combinations of features**
- **Test feature interactions, usability**

Standard-Driven Tests

- **Follow structure of standard document**

- **Generally one program per package**

- **Test cases derived directly from analysis of the standard**
  - **correct names, parameters**
  - **error handling**
  - **correct effect, in simple cases**

Sample Test Program

```
with Calendar,
     POSIX,
     POSIX_Limits,
     ...
     POSIX_Timers;
procedure p140100 is
   use POSIX,
      ...
      POSIX_Timers;
begin
   Header ("p140100", Root_OK => True);

   ... tests ...

   Done;
exception
when E1 : POSIX_Error =>
   Optional (Timers_Option,
     Operation_Not_Implemented, E1);
   Done;
when E2 : others => Fatal_Exception (E2);
end p140100;
```

Sample Test

```
--   Arming timer with zero initial value
--   raises POSIX_ERROR with error code Invalid_Argument.
begin
  Set_Initial (State, Zero_Timespec);
  Set_Interval (State, Zero_Timespec);
  Arm_Timer (Timer, Absolute_Timer, State);
  Expect_Exception ("A034");
exception
when E1 : POSIX_Error =>
  if Get_Error_Code /= Invalid_Argument then
    Optional(Timers_Option,
      Operation_Not_Supported, E1, "A035");
  end if;
when E2 : others => Fail (E2, "A036");
end;
```

Sample Output

```
,.,. p050100 POSIX Ada Validation Tests, Version 1.2
==== Test Completed Successfully.


,.,. p050200 POSIX Ada Validation Tests, Version 1.2
     !!TEST FAILED: A051: times out of order by  18000s
     !!TEST FAILED: A053: times out of order by  18000s
==== Failed 2 tests.
```

- **Verbosity controllable by command line argument**
- **This is middle verbosity level**

POSIX Realtime Options and Ada Packages

• **Asynchronous I/O**	**POSIX_Asynchronous_IO**
• **File Synchronization**	**POSIX_IO***
• **Prioritized I/O**	**POSIX_IO***
• **Synchronized I/O**	**POSIX_IO***
• **Memory Mapped Files**	**POSIX_Memory_Mapping**
• **Memory Locking**	**POSIX_Memory_Locking**
• **Memory Range Locking**	**POSIX_Memory_Range_Locking**
• **Memory Protection**	**POSIX_Memory_Protection**
• **Message Queues**	**POSIX_Message_Queues**
• **Mutex Priority Ceiling**	**POSIX_Mutexes**
• **Mutex Priority Inheritance**	**POSIX_Mutexes**
• **Mutexes**	**POSIX_Mutexes**

POSIX Realtime Options and Ada Packages

- **Mutexes**   POSIX_Condition_Variables
- **Process Shared**   POSIX_Mutexes,
                                                              POSIX_Condition_Variables

- **Priority Process Scheduling**   POSIX_Process_Scheduling
- **Priority Task Scheduling**   Ada.Dynamic_Priorities,
                                                              pragmas, *etc.*

- **Shared Memory Objects**   POSIX_Shared_Memory_Objects
- **Semaphores**   POSIX_Semaphores
- **Realtime Signals**   POSIX_Signals*,
                                                              Ada.Interrupts

- **Signal Entries**   POSIX_Signals*
- **Timers**   POSIX_Timers

Test Coverage Matrix (Key)

	R	P	A	S	U
Realtime area	x				
Realtime features added	+				
Realtime minor modifications	.				
Package interfaces exist to test		x			
ACVC already provides coverage			x		
Specific tests exist				x	
Specific tests planned for next prototype				*	
Used in other tests heavily					x
Used moderately					+

Section	Package/Topic	R	P	A	S	U	Tests
1-2.3	Introduction						
2.4	POSIX	.	x		x	x	p020400
2.5	POSIX_Options	+	x		x	x	
2.6	POSIX_Limits	+	x			x	
2.7	Ada_Streams	+	x	x		+	
2.8	System	.	x	x		+	
2.9	System_Storage_Elements	.	x	x		+	
2.1	POSIX_Page_Alignment	x	x		x	x	p021000
2.11	Environment Description						

Chapter 3 & 4 Tests

Section	Package/Topic	R	P	A	S	U	Tests
3.1	POSIX_Process_Primitives	x	x		x	x	p030100-01
3.2	POSIX_Unsafe_Process_Primitives	.	x		x		p030200
3.3	POSIX_Signals	+	x		x	x	p030300
4.1	POSIX_Process_Identification		x		x	x	p040100-01
4.2	POSIX_Process_Times		x				p040100
4.3	POSIX_Process_Environment		x		x	x	p040300-01
4.4	POSIX_Calendar		x		x	+	p040300
4.5	POSIX_Configurable_System_Limits		x		x	+	p040300

Chapter 5 & 6 Tests

Section	Package/Topic	R	P	A	S	U	Tests
5.1	POSIX_Permissions		x		x	+	p050100
5.2	POSIX_Files	.	x		x	x	p050200
5.3	POSIX_File_Status	.	x		x	x	p050300
5.4	POSIX_Configurable_File_Limits	.	x			.	p050300
6.1	POSIX_IO	.	x		x	x	p060100
6.2	POSIX_File_Locking		x		x		p060200
6.3	POSIX_Asynchronous_IO		x		x	.	p060300

Chapter 7-10 Tests

Section	Package/Topic	R	P	A	S	U	Tests
7.1	General Terminal Interface						
7.2	POSIX_Terminal_Functions		x		x		p070200
8.1	Interoperable Ada I/O Services						
8.2	POSIX_Supplement_To_Ada_IO		x		x		p090100
9.1	POSIX_User_Database		x		x		p090100
9.2	POSIX_Group_Database		x		x		p090200
10	Data Interchange Format						

Chapter 11& 12 Tests

Section	Package/Topic	R	P	A	S	U	Tests
11.1	POSIX_Semaphores	x	x		x	x	p110101
11.2	POSIX_Mutexes	x	x		x	x	p110200-01
11.3	POSIX_Condition_Variables	x	x		x	x	p110300
12.1	POSIX_Memory_Locking	x	x		x		p120100-01
12.2	POSIX_Memory_Range_Locking	x	x		x		
12.3	POSIX_Memory_Mapping	x	x		x		p120300
12.4	POSIX_Shared_Memory_Objects	x	x		x	+	p120400
12.5	POSIX_Generic_Shared_Memory	x	x		x		p120500-02

Chapter 13-16 Tests

Section	Package/Topic	R	P	A	S	U	Tests
13.1	Scheduling Concepts & Terminology	x					
13.2	POSIX_Process_Scheduling	x	x		*	x	
13.3	Task Scheduling	x		x		x	
13.4	Synchronization Scheduling	x			*	+	
14.1	POSIX_Timers	x	x		x	x	p140100
14.2	High Resolution Delay	x		x		+	
15.1	POSIX_Message_Passing	x	x		x	x	p150100-01
16.1	Ada_Task_Identification	x	x	x		+	

99-series: Periodic Rate Monotonic Task Scenario

	10	20	30	*
tasks	x	x	x	
processes				*
Calendar.Clock			x	
Ada.Real_Time.Clock				
POSIX.Calendar.Clock	x			
Clock_Realtime		x		*
delay statement	x		x	
timers				*
Timed_Wait		x		
protected objects			x	
semaphores				*
mutexes and CVs	x	x		
Communication				
local memory	x	x	x	
shared memory				*